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EXAMINER

VINH, LAN

ART UNIT

PAPER NUMBER

1765

DATE MAILED: 05/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/418,031

Applicant(s)

JANG ET AL.

Examiner

LAN VINH

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 19 February 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-11 and 21 is/are allowed.
- 6) ☒ Claim(s) 12-20, 22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. & 119(e).

Attachment(s)

- 15) ☒ Notice of References Cited (PTO-892)
- 16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3, 4.
- 18) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 19) ☐ Notice of Informal Patent Application (PTO-152)
- 20) ☐ Other: _____.

DETAILED ACTION***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made

2. Claims 12-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhao et al (US 6,100,184) in view of Huang et al (US 6,191,484) and further in view of Cronin et al (US 5,759,911)

Zhao discloses a method for making a dual damascene interconnect. This method comprises the steps of:

forming a substrate having a aluminum/metal conductive region (contact stud) 10 (col 4, lines 14-16)

forming over the substrate a lower dielectric organic polymer layer 14 (polyimide) and a upper dielectric etch stop layer 15 (col 6, lines 10-25 and fig. 3) reads on forming over the substrate a first lower organic polymer sub-layer and a second upper sub-layer

forming over the lower layer 14 and upper layer 15, an interlevel dielectric (ILD) layer 19 (silicon dioxide) (col 6, lines 61-65; fig. 11 shows that layer 19 is formed between layers 28 and 18)

forming over the IDL layer 19 a photoresist mask pattern 22 to define a subsequent via opening and trench opening centered over the contact region (col 7, lines 19-23 and

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fig. 7), utilizing a first plasma etching to etch through the ILD layer 19 and upper layer 15 to the lower polymer layer 14 (col 7, lines 25-34)

removing/stripping the photoresist mask and simultaneously etching the lower polymer layer 14 to complete the interconnection over the aluminum contact region (col 7, lines 30-45)

Unlike the instant claimed invention as per claim 12, Zhao does not specifically disclose using the first lower layer and second upper layer as a composite etch stop layer although Zhao discloses using the second upper layer 15 as an etch stop layer.

However, Huang , in a method of forming multilevel metallization integrated circuit using etching, teaches that the etch stop layer may comprise a multiple layer/composite layer (col 4, lines 56-57)

Hence, one skilled in the art would have found it obvious to modify Zhao method by using the first lower layer and second upper layer as a composite etch stop layer in view of Huang's teaching because Huang states that additional layer added to the single etch stop layer to form multiple-layers etch stop provides better etch stop control (col 4, lines 64-66)

Zhao and Huang also differ from the instant claimed invention as per claim 12 by using a contact region of aluminum instead of tungsten.

Cronin teaches that aluminum or tungsten can be used to fill contact region or stud connection in a semiconductor structure (col 10, lines 3-5)

Hence, one skilled in the art would also have found it obvious to substitute Zhao and Huang aluminum contact stud with tungsten stud in view of Cronin's teaching because

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aluminum and tungsten are known conductive material, thus the substitution of one for the other would have produced an expected result.

Regarding claim 13, fig. 8 of Zhao shows that the lower layer 14 prevents the etching of the conductor region 10.

Regarding claims 14, 20, Zhao discloses forming a barrier metal layer 28 (TaN) over the substrate and filling the trench with a conductor material to complete the interconnection structure (col 8, lines 35-40)

Regarding claim 16, Zhao discloses that lower polymer layer comprises of low dielectric constant spin-on-polymer such as polyimide (col 6, lines 15-17)

Regarding claim 17, Zhao discloses that upper layer 15 (silicon dioxide) is formed by CVD (col 6, lines 24-26)

Regarding claim 19, Zhao discloses filling the trench with aluminum or copper (col 8, lines 43-44)

3. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhao et al (US 6,100,184) in view of Huang et al (US 6,191,484) and Cronin et al (US 5,759,911) and further in view of Qiao et al (6,372,634)

Zhao as modified by Huang and Cronin has been described above. Unlike the instant claimed invention as per claim 22, Zhao, Huang and Cronin do not specifically disclose employing a gas mixture of CF₄, CHF₃, oxygen and argon in the etching steps.

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However, Qiao, in a method of improving etch control, teaches that a mixture of CF₄, CHF₃, oxygen and argon can be used to etch opening in the dielectric layer (col 1, lines 42-46)

Hence, one skilled in the art would have found it obvious to modify Zhao, Huang and Cronin method by performing the etching step using a gas mixture as per Qiao because according to Qiao, in most modern process of forming openings in the dielectric layer, one or more halocarbons and other halogenated compounds and other gas are typically used as the etchant gas (col 1, lines 37-44)

Allowable Subject Matter

4. Claims 1-11, 21 are allowed.

Regarding claim 1, the cited prior art of record fails to disclose forming on the at least one conductor stud a first lower sub-layer and a second upper sub-layer to provide a composite etch stop layer. The closest prior art of Huang et al (US 6,191,484) discloses forming a first lower sub-layer 24 and a second upper sub-layer 26 to provide a composite etch stop layer over the conductor stud 12.

Response to Arguments

5. Applicant's arguments filed 2/19/2002 with respect to the Huang reference have been fully considered but they are not persuasive.

The applicants argue that Huang teaches away for the instant claimed invention because the underlayer 24 of Huang is a glue layer, not an etch stop layer. The

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examiner disagrees because as clearly recited in col 4, lines 55-57 of Huang, Huang discloses that the etch stop layer may comprise a single layer 24. In response to the argument that in fig. 2A and 2B and disclosed at col 5, lines 21-31 of Huang, a photoresist is not formed and a CMP is employed, the examiner notes that Huang discloses the step of patterning layer 22 (col 4, lines 53-54) and as known in the art patterning requires the step of forming photoresist/resist . Although, Huang discloses that CMP is employed , Huang also discloses that other suitable method of etching may also be employed (col 5, lines 29-31). Thus, the examiner maintains the rejection of claims 12-20 under 35 U.S.C 103 based on Zhao, Huang and Cronin, as described above.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 703 305-6302. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872-9310 for regular communications and 703 872-9311 for After Final communications.



LV
May 3, 2003